The occurrence and habitat conditions of *Anthoxanthum puelii* Lecoq & Lamotte and other Atlantic-Mediterranean weed species in Hungary

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**Summary**

During 2004 and 2005 large stands of *Anthoxanthum puelii* were discovered in south-western Hungary in “Belső-Somogy” region. These habitats are characterized by the coincidence of climatic and edaphic conditions favourable for this species. Soils in this territory are mainly acidic sandy and the climate is distinctive Subatlantic-Submediterranean. It is uncertain, whether *A. puelii* is a long established species or whether its invasion in Hungary has just started, because details about its introduction to Hungary are unknown. Hungarian distribution and habitat conditions of other Atlantic-Mediterranean weed species, such as *Aphanes microcarpa*, *Spergula pentandra*, *Thlaspi alliaceum* and *Teesdalia nudicaulis* are also discussed. These are retreating and endangered plants. According to earlier references *Arnoseris minima* and *Chrysanthemum segetum* also occurred in Hungary, but they seem to have disappeared from our flora for two centuries.

**Keywords:** Weed flora, weed-grasses, climate, acidic sand, rare species

**Zusammenfassung**

Das Vorkommen und Standortverhältnisse von *Anthoxanthum puelii* Lecoq & Lamotte und anderen atlantisch-mediterranen Unkrautarten in Ungarn


**Stichwörter:** Unkrautfloa, Ungräser, Klima, saure Sandacker, seltene Ackerwildkräuter
Introduction

Anthoxanthum puelii Lecoq & Lamotte (Anthoxanthum aristatum Boiss) is a characteristic weed species in poor acidic sandy soils in the Atlantic-Subatlantic regions of western and south-western Europe. Its winter annual behaviour is associated with frost sensitivity. Due to the increasing effect of continental climate it can be found only in isolated areas in Central-Europe (e.g. in southern Germany) where the particular edaphic and microclimatic factors coincide (NEZADAL 1981). In arable land it occurs almost exclusively in cereal crops, it prefers mainly winter rye fields. Among Central-Europe’s vegetal communities it links strictly to Arnoseridenion alliances (Teesdalio-Arnoseridetum respectively Arnoserido-Scleranthetum associations), it is a characteristic species of these units (MEISEL 1969, HÜPPE and HOFMEISTER 1990, KULP 1993, WARCHOLINSKA 1995, ROSTANSKI 1996, HOFMEISTER and GARVE 1998). It is reported to have also several occurrences in ruderal places, on roadside verges, in sand-pits and in railway areas (SUKOPP 1994). According to CONERT (2000) it often appears as a typical “railway station plant” (“Bahnhofspflanze”). Its fast and successful far wandering in the past was due to “speirochorie”, namely among seeds of fodder-grasses (e.g. Anthoxanthum odoratum), fodder-crops, rye and oat. These days anthropogenic harvesting plays a significant role in spreading, since the combine harvesters blow the small seeds of harvested weeds together with the chaff back to the fields (SUKOPP 1994, BONN and POSCHLOD 1998). It was introduced to Germany probably in the “Napoleonic times” (1805-1813), to England also with French intervention with seeds of fodder-crops in the second half of the 19th century (SUKOPP 1994). Its spreading in Poland from west to east is still in process. In Central-Poland between 1975 and 1995 the number of localities increased from 118 to 555. Severe infestation decreases yields of crops, and has a destructive impact on weed associations (WARCHOLINSKA and SICINSKI 1976, 1996). On the Kaluszyńska Upland in East-Poland in 1985 A. puelii was known as a rare species from 6 localities, but in 2002 it was recorded in 61 localities. At the beginning of its spread this species seemed not to have serious threat to cereal cultivation in that region because of its sparse abundance, but nowadays it infests rye canopy extensively and overgrows stubble fields as well (CIOSEK and SKRZYCZYNSKA 1997, SKRZYCZYNSKA et al. 2004). To its invasive success in Germany and Poland presumably also contributed that weed-grasses are not sensitive to the broadly used herbicides in cereals, so they replaced vanished species as a compensative effect (MEISEL 1966, SUKOPP 1994).

In Hungary SÁNDOR POLGÁR found the first specimen of A. puelii in 1911, in the town of Győr (north-western Hungary) on the riverbank of Rába (POLGÁR 1912, 1941). Then it was discovered again only in 1998, in the Lesser Plain of north-western Hungary at the edge of an extensively cultivated cereal field (PINKE 1999, 2000). Later during 2004 and 2005 it was found in several localities in south-western Hungary, mainly in “Belső-Somogy” region (Fig. 1). On the basis of the vital and extended populations it can be stated, that A. puelii can be regarded as an established species in Hungary, namely in arable fields and probably in pioneer grasslands as well. In this paper the occurrence and habitat of Anthoxanthum puelii in Hungary are presented and complementary the Hungarian distribution of four other Atlantic-Mediterranean weed species, such as Aphanes microcarpa, Spergula pentandra, Thlaspi alliaceum and Teesdalia nudicaulis, is also discussed.

Materials and methods

The surveys have been carried out since 1995 within the frame of phytosociological surveys on extensive fields (PINKE 2000), and the Mapping Programme for Hungarian Flora (KIRÁLY and HÖRVÁTH 2000). The floristic data of the five examined species were encoded according to NIKLFELD (1971) by using the CEU mapping system. Besides the current occurrences discovered by the authors of this paper, data from contemporary and early literature and also from the herbarium collection of the Hungarian Natural History Museum were encoded and illustrated on maps (Figs. 1-4.).

The phytosociological records on stands, where Anthoxanthum puelii occurred, were made at the end of May and in the first part of June 2005 in south-western Hungary in “Belső-Somogy” region, with the exception of record 15, which was created in June 1998 in the Lesser Plain of north-western Hungary. The sampling areas were 50 m², and it was used in the estimation method of BRAUN-BLANQUET. On 12 surveyed sites soil samples were collected and their pH-values were measured (Tab. 1).
### Table 1: Phytosociological records of habitats of Anthoxanthum puelii in Hungary.

Tab. 1: Pflanzensozio逻辑ische Aufnahmen auf den Standorten von Anthoxanthum puelii in Ungarn.

<table>
<thead>
<tr>
<th>Record-number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
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<tr>
<td>Total coverage (%)</td>
<td>60</td>
<td>85</td>
<td>90</td>
<td>75</td>
<td>65</td>
<td>90</td>
<td>95</td>
<td>80</td>
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<td>80</td>
<td>75</td>
<td>65</td>
<td>90</td>
</tr>
<tr>
<td>Coverage of crop (%)</td>
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<td>60</td>
<td>1</td>
<td>65</td>
<td>20</td>
<td>35</td>
<td>30</td>
<td>10</td>
<td>20</td>
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<td>20</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Coverage of weeds (%)</td>
<td>60</td>
<td>30</td>
<td>95</td>
<td>35</td>
<td>80</td>
<td>50</td>
<td>30</td>
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<td>40</td>
<td>5</td>
<td>90</td>
<td>5</td>
<td>30</td>
<td>65</td>
<td>75</td>
</tr>
<tr>
<td>Soil pH (H₂O)</td>
<td>5,87</td>
<td>5,19</td>
<td>5,89</td>
<td>5,26</td>
<td>.</td>
<td>.</td>
<td>5,95</td>
<td>5,83</td>
<td>6,57</td>
<td>4,96</td>
<td>6,13</td>
<td>5,52</td>
<td>5,53</td>
<td>5,97</td>
<td></td>
</tr>
<tr>
<td>Soil pH (KCl)</td>
<td>4,76</td>
<td>4,13</td>
<td>4,79</td>
<td>4,24</td>
<td>.</td>
<td>.</td>
<td>4,92</td>
<td>4,54</td>
<td>6,16</td>
<td>4,05</td>
<td>5,24</td>
<td>4,25</td>
<td>4,41</td>
<td>5,11</td>
<td></td>
</tr>
<tr>
<td>Number of species</td>
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<td>20</td>
<td>29</td>
<td>18</td>
<td>28</td>
<td>15</td>
<td>19</td>
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<td>16</td>
<td>19</td>
<td>23</td>
<td>37</td>
<td>39</td>
<td>25</td>
</tr>
</tbody>
</table>

### Crops

- **Triticum aestivum**
- **Secale cereale**
- **Lolium perenne**
- **Lamium purpureum**
- **Lactuca serriola**
- **Triticale rimpaui**
- **Secale cereale**
- **Triticum aestivum**
- **Arabidopsis thaliana**
- **Apera spica-venti**
- **Vulpia myuros**
- **Viola arvensis**
- **Vicia villosa**
- **Brassica napus**
- **Fallow**
- **Gypsophila muralis**
- **Galium aparine**
- **Digitaria sanguinalis**
- **Conyza canadensis**
- **Convolvulus arvensis**
- **Chenopodium album**
- **Cerastium glomeratum**
- **Centaurea cyanus**
- **Capsella bursa-pastoris**
- **Anthoxanthum puelii**
- **Anthemis ruthenica**
- **Anthemis austriaca**
- **Anthemis arvensis**
- **Ambrosia artemisiifolia**
- **Alopecurus aequalis**

### Weeds

- **Alopecurus aequalis**
- **Ambrosia artemisiifolia**
- **Anthemis ruthenica**
- **Anthemis austriaca**
- **Anthemis arvensis**
- **Ambrosia artemisiifolia**
- **Apera spica-venti**
- **Vulpia myuros**
- **Viola arvensis**
- **Vicia villosa**
- **Brassica napus**
- **Fallow**
- **Gypsophila muralis**
- **Galium aparine**
- **Digitaria sanguinalis**
- **Conyza canadensis**
- **Convolvulus arvensis**
- **Chenopodium album**
- **Cerastium glomeratum**
- **Centaurea cyanus**
- **Capsella bursa-pastoris**
- **Anthoxanthum puelii**
- **Anthemis ruthenica**
- **Anthemis austriaca**
- **Anthemis arvensis**
- **Ambrosia artemisiifolia**
- **Alopecurus aequalis**

Species with value '+' in one or two records only:

- **Anthoxanthum puelii**
- **Anthemis ruthenica**
- **Anthemis austriaca**
- **Anthemis arvensis**
- **Ambrosia artemisiifolia**
- **Alopecurus aequalis**

Localities of the records (CEU codes): Nagykorpád (9770); 1; Szabázs (9770); 2; Kiskuny (9670); 3; Kutat (9670); 4; Szulok (9971); 5; Mike (9771); 6; Szenta (9768); 7; 8; Csisköly (9771); 9; Berzence (9768); 10; between Szenta and Berzence (9769); 11; Pat (9569); 12; 13; Pálm (9671); 14; Nemesszeresztr (8969); 15.
Results and discussion

The habitat characterization of Anthoxanthum puelii in Hungary

According to this survey the distribution of *Anthoxanthum puelii* is restricted almost exclusively to the region “Belső-Somogy” in south-western Hungary (Fig. 1). The greatest part of this territory has acidic sandy soil. The climate here shows a strong Subatlantic-Submediterranean effect with average 780–830 mm precipitation in a year, with uniform precipitation distribution, but with a pronounced second precipitation-maximum in autumn (BORHIDI 1958). After VARGA (2003) the monthly average frost (temperature below -5°C) occurrence is the lowest here in Hungary (with the exception of Budapest) and the common occurrence of Mediterranean and Atlantic climatic types is also the highest in the “Somogy” region (VARGA-HASZONITS et al. 2003). This climatic character is manifested chorologically as well.

According to BORHIDI (1958) more than 50 % of the Atlantic-Mediterranean elements of the Hungarian flora grow in this region.

On the basis of our phytosociological records *Anthoxanthum puelii* occurred in winter cereal fields (mostly in triticale, as well as rye and wheat), in winter rape and on first year fallow (on uncultivated stubbles of maize, sunflower and oil radish, and as well as after rye) (Tab. 1). It appeared sparsely or also in great quantities, but only in the lower herb layers, and visually it seemed to have not caused any serious damage to the cultivated plants. The degree of the farmland intensification was very different, e.g. the records 5 and 15 were on extensively cultivated plots, record 2 was in a stand strongly affected by herbicides, record 10 – where its canopy dominated almost 100 % – was situated patchy on a deeper positioned part of an intensively cultivated field. (In this latter site also on the late summer stubble the withered specimens of this weed created a carpet stand). Moreover it grew in corners of large fields left unintentionally unsprayed, on field edges, and on plots where there were not herbicides treatments every year, or with the imperfect application of herbicides. Thereby these latter mentioned habitats formed a transition between intensively and extensively cultivated systems.

Among the associated species only four reached the 80-100 % frequency: *Ambrosia artemisiifolia*, *Apera spica-venti*, *Elymus repens* and *Viola arvensis* (Tab. 1). *(Ambrosia artemisiifolia* became the most dominant species in the autumn aspect of the harvested stubbles and fallow). Among others that reached 40-60 % frequency some species are typical for sandy soils: e.g. *Anthemis ruthenica*, *Conyza canadensis*, *Veronica triphylos*; species typical for acidic soils: e.g. *Scleranthus annuus*; and as well as *Centauraea cyanus*, *Matricaria chamomilla*, *Lamium purpureum*, *Equisetum arvense* and *Arabidopsis thaliana*. The Atlantic-Mediterranean *Spergula pentandra* occurred in three, while *Aphanes microcarpa* in two records. It is very remarkable that in other regions still abundant species preferring basic soil types, such as *Papaver rhoesas*, *Consolida regalis*, *Sinapis arvensis* and *Avena fatua* are very rare or totally absent from these records. This weed survey was carried out in the early summer, an aspect that was reflected also in the life-form spectrum: the accompanying species are mainly winter annuals. In addition *A. puelii* was once discovered in September also in a fallow cultivated in late spring. This population was dominated by *Digitaria sanguinalis*. Outside arable habitats a significant occurrence of *A. puelii* was found also in a strip under electric cables in pioneer grassland community with the following significant associated species: *Jasione montana*, *Holcus mollis* and *Digitaria sanguinalis*.

Other Atlantic-Mediterranean weed species in Hungary

*Aphanes microcarpa* (BOISS. & REUT.) ROTHM.

The critical taxonomical position of this species is reflected in its several synonyms (LIPPERT 1984, TRIBSCH 2001). It was firstly demonstrated in Hungary in the “Belső-Somogy” region (south-western Hungary), during herbal revision by BOROS (1956). Later it was found by KÁROLYI and PÓCS (1964, 1969) as well in the vicinity of Óriszentpéter (west-Hungary). Its current occurrence in “Belső-Somogy” region was confirmed by MOLNÁR et al. (2000), and according to recent surveys of the authors of this paper, its current occurrences are also known in the regions of “Belső-Somogy”, “Kemeneshát”, Bakony-mountain and in the Lesser Plain in north-western Hungary (Fig. 2). This plant grows on extensively cultivated fields, in first year fallow and in fire service-strips along forest edges. This species was supposedly always very rare in Hungary, just as well as in the neighbouring Austria, where because of its rarity TRIBSCH (2001) presumes that the farmland intensification could not cause a further area-loss.

*Ambrosia artemisiifolia* (L.), *Apera spica-venti* (L.), *Elymus repens* (L.), *Viola arvensis* (L.) and *Anthoxanthum puelii* occurred in three, while *Spergula pentandra* in two records. It is very remarkable that in other regions still abundant species preferring basic soil types, such as *Papaver rhoesas*, *Consolida regalis*, *Sinapis arvensis* and *Avena fatua* are very rare or totally absent from these records. This weed survey was carried out in the early summer, an aspect that was reflected also in the life-form spectrum: the accompanying species are mainly winter annuals. In addition *A. puelii* was once discovered in September also in a fallow cultivated in late spring. This population was dominated by *Digitaria sanguinalis*. Outside arable habitats a significant occurrence of *A. puelii* was found also in a strip under electric cables in pioneer grassland community with the following significant associated species: *Jasione montana*, *Holcus mollis* and *Digitaria sanguinalis*.
According to KÄSTNER et al. (2001) this species has significantly retreated in other parts of Central-Europe recently.

*Spergula pentandra* L.
The presence of *Spergula pentandra* in Hungary was first recorded by RAPAICS (1916), who characterized this species as a widespread fallow-weed in the sandy area of Debrecen (north-eastern Hungary). Later it was discovered also by GONDOLA (1969) in the same part of Hungary, in the vicinity of several settlements of the “Nyírség” region. It grew in rye fields, in maize stubbles left uncultivated till spring, along farm roads and in fallow. In south-western Hungary it was found also on acidic sand by BOROS (1924), KÁROLYI and PÓCS (1957). Its current data are known from regions of “Nyírség”, Vértes-mountain, “Belső-Somogy”, west-Hungary and Lesser Plain of north-western Hungary (Fig. 3). It occurs in secondary grasslands, on pastures, fallow, in scarlet clover (*Trifolium incarnatum*) and rye fields (*PINKE and PÁL 2001, MATUS and PAPP 2003, MATUS et al. 2005, BARINA 2005). In the adjacent Burgenland (East-Austria) it was observed by HOLZNER (1971) on the edges of arable fields on acidic sandy soil. From the neighbourhood of the river Moravia (Slovakia and Czech Republic) it was reported by Dvorák (1983) and by STANOVA and GRULICH (1993), the latter from pioneer meadows (*Sedo-Scleranthetea*). It is very noticeable, that *Spergula pentandra* occurs in all these relatively acidic sandy environments of the Carpathian-Basin. This species is already threatened in Austria with extinction (ADLER et al. 1994).

*Thlaspi alliaceum* L.
*Thlaspi alliaceum* is a rare arable weed in south-western and in north-eastern Hungary (Fig. 4). From south-western Hungary it was last reported by KÁROLYI et al. (1972). In the years of 2003-2004 it was discovered by the present authors and by CSIKY (2005) in a few localities of two south-west Hungarian areas: “Zala” and “Baranya”. It occurred on extensively cultivated fields and vineyards, first year fallow and along farm roads, sparsely and massive as well. On arable fields the most frequent associated species were: e.g. *Scleranthus annuus, Aphanes arvensis, Sherardia arvensis, Anthemis arvensis, Centaurea cyanus, Vicia grandiflora*; in vineyards: e.g. *Lamium purpureum, Stellaria media, Euphorbia helioscopia, Holosteum umbellatum, Erophila verna, Senecio vulgaris, Veronica persica, Veronica hederifolia*. Like KÁROLYI and PÓCS (1968) previously also pointed out, the mild Subatlantic-Submediterranean climate of this region creates favourable conditions for the occurrence of *T. alliaceum* in south-western Hungary and it surely has even more occurrences in this region.

*Teesdalia nudicaulis* (L.) R. Br.
It is one of the name-giving character species of the Atlantic *Teesdalio-Arnoseridetum* association (HÜPPE and HOFMEISTER 1990). This community doesn’t exist in Hungary. Nearest to our country it was reported in Lower-Austria, where *Arnoseris minima* had a large while *Teesdalia nudicaulis* had a low frequency, and this latter species was rather characterized as a typical pioneer plant of open sandy areas (HOLZNER 1973).

In the north-western part of Hungary *Teesdalia nudicaulis* was mentioned in some flora work from the 19th century, but researchers didn’t manage to confirm these occurrences (SZONTAGH 1864, PECK 1878, GOMBOCZ 1906, KIRÁLY 2004). Then it was discovered by KÁROLYI et al. (1972) in south-western Hungary (in the vicinity of Őrtilos) on acidic sandy grasslands and arable fields. Since then it wasn’t found in arable fields any more, but in other habitats several current populations are known. In “Belső-Somogy” region (south-western Hungary) it grows in secondary grasslands dominated mainly by *Corynephorus canescens*, more rarely by *Vulpia myuros*, and in edges of coniferous wood plantations, along roads and on wildlife forage areas (MOLNÁR 2003, LÁJER 2004).

It is remarkable, that *Arnoseris minima* and *Chrysanthemum segetum* also have old floristic records from west-Hungary (SZONTAGH 1864, GOMBOCZ 1906, SOÓ 1970, KIRÁLY 2004), but they have not been sighted for two centuries.
Fig. 1: Distribution of *Anthoxanthum puelii* in Hungary (○: data from a riverbank in 1911; ●: current occurrences).

Abb. 1: Die Verbreitung von *Anthoxanthum puelii* in Ungarn (○: Angabe von einem Flussufern in 1911; ●: aktuelle Vorkommen).

Fig. 2: Distribution of *Aphanes microcarpa* in Hungary (○: data between 1923 and 1969; ●: current occurrences).

Habitat and occurrence of *Anthoxanthum puelii* in Hungary

Fig. 3: Distribution of *Spergula pentandra* in Hungary (○: data between 1916 and 1969; ●: current occurrences).


Fig. 4: Distribution of *Thlaspi alliaceum* in Hungary (○: data from 1960; ●: current occurrences).

**Abb. 4**: Die Verbreitung von *Thlaspi alliaceum* in Ungarn (○: Angabe von 1960; ●: aktuelle Vorkommen).
Conclusions

In accordance with abiotic aspects it can be stated, that Atlantic-Mediterranean weed species occur in Hungary, where they find suitable edaphic conditions. *Anthoxanthum puelii* grows exclusively on acidic sand, *Aphanes microcarpa* in acidic sandy or gritty habitats, *Spergula pentandra* on acidic sand and clay-gravel, and *Thlaspi alliaceum* rather on loamy, acidic or neutral soils. Similar observations are in literature references (Ujvárosi 1973, Adler et al. 1994, Kästner et al. 2001). It is notable, that in the south-western part of Hungary – where *Anthoxanthum puelii* and all of the other here discussed Atlantic-Mediterranean weed species have their distribution centre – the suitable edaphic factors coincide with favourable Subatlantic-Submediterranean climate character. *Spergula pentandra* and *Thlaspi alliaceum* however appear also in north-eastern Hungary, where the Continental climatic type prevails. Therefore the Hungarian distribution of these two species seems not to be primarily determined by the climate, but rather by the soil.

Among the Atlantic-Mediterranean weed species discussed in this paper *Anthoxanthum puelii* seems to be spreading, while the others are retreating endangered plants. Hence it should be emphasized, that the current arable occurrence of *Aphanes microcarpa*, *Spergula pentandra* and *Thlaspi alliaceum* beyond the abiotic factors depends first of all on extensive cultivation methods. *Teesdalia nudicaulis* has been no longer found in arable habitats for the last decades. Although its arable appearance could be possible, in the near vicinity of its known localities there is no arable cultivation. *Arnoseris minima* and *Chrysanthemum segetum* have disappeared from the Hungarian Flora for a long time already.

The origin of the introduction of *A. puelii* to Hungary is unknown. Also questionable is whether it is a long established species in the surveyed area (and earlier it merely escaped the attention of botanists) or its invasion has just started in Hungary. It might be possible that it arrived in the last two decades in the seed-tanks of second-hand combine harvesters bought by the Hungarian little farmers from North-Germany. Has the spread of this species anything to do with global warming, as it is supposed to be the case with other species as well (Glemnitz et al. 2000, Káinczy et al. 2004, Solymosi 2005)? The restricting factor to the expansion of this weed is mainly its frost-sensitivity. According to Varga (2003), as far as frost is concerned, Hungary experienced no climate change in the last decades, thereby this assumption can not be supported with meteorological data. Nevertheless, if the global warming played any role in the acceleration of the spread of *A. puelii* after all, the question is raised whether it would be limited by the edaphic requirements of this plant, restricting it henceforward to acidic sandy soils? Now it is difficult to predict whether the further spreading of this species can lead to no more than only local weed problems in Hungary, or whether – similarly to Germany and Poland – to more considerable infestations.

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References

Habitat and occurrence of *Anthoxanthum puelii* in Hungary


